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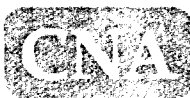
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NAVY NURSE CORPS COMPENSATION

Timothy W. Cooke

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ABSTRACT

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EXECUTIVE SUMMARY

The national nurse shortage is raising concerns about recruiting and retention in the Navy Nurse Corps. Because relative compensation is believed to affect career choice, the Navy Medical Blue Ribbon Panel and the Office of the Secretary of Defense (Health Affairs) Health Care Professionals Special Pays working group have been studying Nurse Corps compensation relative to civilian nurse compensation. The Navy Surgeon General (OP-093) and the Director of Program Planning (OP-81) asked the Center for Naval Analyses (CNA) to provide supporting analysis in that effort.

The objectives of this research are to characterize and quantify Navy Nurse Corps compensation relative to civilian opportunities and to evaluate the relation between relative compensation and retention. The principal findings are the following:

- Nurse Corps compensation has historically been high relative to civilian nurse compensation.
- Civilian nurse pay rates, adjusted for experience, rose faster than Regular Military Compensation (RMC) between 1983 and 1988. Because data on the value of non-wage compensation and benefits are not available, this conclusion is based on a comparison of wage compensation only.
- During the first four years of service, Nurse Corps compensation increases about three times faster with experience (10 to 11 percent per year on average) than does civilian nurse compensation. For years of service 4 through 20, Nurse Corps compensation increases just over 3 percent per year. Excluding military retirement benefits, this is similar to civilian nurse compensation profiles. Including the value of military retirement benefits is likely to increase the relative compensation of military nursing.
- Relative military compensation at the end of initial obligation (three years of service) declined 16 to 22 percent between 1983 and 1987 due largely to reduced promotion opportunity in the Nurse Corps.
- In 1986, the median RMC of Navy nurse anesthetists exceeded the median reported income of the members of the American Association of Nurse Anesthetists. More recent evidence indicates that civilian nurse anesthetist compensation has been increasing more quickly than regular military compensation.

- Because the increase in civilian nurse compensation is expected to exceed the increase in Navy Nurse Corps compensation, nurses at the end of their initial obligation may observe a decline of about \$1,500 in annual relative military compensation during FY 1989. Such a change is estimated to be associated with a loss rate 3 to 4 percentage points higher than if there were no change in relative military compensation. This translates to about ten additional losses in a year.

POLICY IMPLICATIONS

Relative military compensation influences both recruiting and retention. Though Nurse Corps compensation has declined relative to civilian nurse compensation over the past five years, there is little empirical evidence of a substantial reduction in retention, in particular, at the end of initial obligation. By contrast, the recruiting of nurses has become much more difficult for all the services. More attractive offers to starting nurses may be necessary to obtain the desired number of Nurse Corps accessions. If the civilian nurse labor shortage continues and civilian compensation continues to climb, it will be desirable to reevaluate the link between compensation and retention, especially if manning shortfalls occur because of unexpectedly high losses of experienced nurses. In the process, a systematic comparison of changes in non-wage compensation, benefits, and working conditions may be required.

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INTRODUCTION

The Navy Surgeon General and the Director of Program Planning asked CNA to provide supporting analysis to the Navy Medical Blue Ribbon Panel and Office of Secretary of Defense (Health Affairs) Health Care Professionals Special Pays working groups in the areas of Nurse Corps retention and compensation. A previous research memorandum [1] described Nurse Corps retention during the FY 1974 through FY 1988 period. The primary conclusion of that research is that the greatest risk of losing Nurse Corps officers occurs at the end of the initial obligation, which is defined as completion of the three-year direct accession contract. The continuation rate at that point fell from an average of about 67 percent during FY 1983 through FY 1986 to 57 percent in FY 1987 and 63 percent in FY 1988. This decline in retention is thought to be associated with the current national nursing shortage and the resulting increases in nurse compensation in the civilian sector.

This research memorandum characterizes and quantifies Navy Nurse Corps compensation and its relationship to retention. It presents available data on Navy Nurse Corps compensation and some comparisons between civilian and military compensation. Because the greatest opportunity to influence nurse retention occurs at the end of initial obligation, the effect of relative compensation on retention at that point in the military nursing career is analyzed and used to forecast changes in retention. Before presenting the data and analysis, it is useful to discuss the relationship between compensation, benefits, working conditions, and retention. Though hypotheses concerning these relationships are generally straightforward, it is more difficult to obtain unambiguous quantitative measurements of relative compensation. Because of these measurement problems, the results of the empirical analysis must be interpreted with care.

BACKGROUND

Civilian and Military Nurse Compensation

The civilian nurse labor market has a history of cyclic movements in wage rates. Students of the nurse labor market attribute these wage cycles to market dynamics [2, 3]. Nurse compensation, relative to other professions, increases during labor shortages (as indicated by high vacancy rates) and decreases during periods of relatively low nurse vacancy rates. Some analysts [2] have argued that wage movements in the nursing market are somewhat less rapid, and muted, relative to wage movements in other labor markets characterized by excess demand.

The last surge in civilian nurse compensation occurred in 1980 and 1981 in response to the 1979 shortage. Nurses' wages increased an average of 13 percent per year in each of the two years. Partly as a result of this wage growth, the hospital nurse vacancy rate fell in 1984 to its

lowest value (3.7 percent) since 1960. Since 1982, civilian nurse compensation has held steady or increased (depending on experience level) relative to the Consumer Price Index (CPI), but has fallen relative to the compensation of teachers (see [2], p. 643). Nursing school enrollments are decreasing, although labor force participation of registered nurses remains high [2]. There was a sharp increase in hospital nurse vacancy rates in 1986 and growing civilian nursing shortages for the next two years. Between 1985 and 1987, the hospital vacancy rate for full-time equivalent nurses rose from 4 percent to 11 percent.

Independently of civilian nurse compensation cycles, military nurses have experienced a relatively stable compensation environment since the beginning of the All-Volunteer Force (AVF). As military officers, nurses are compensated through regular military compensation (RMC) at the same rates as other officers.¹ Unlike Medical Corps officers, they do not generally qualify for various special pays (see [4]). RMC rates increased nearly 6 percent per year from FY 1974 through FY 1980, and about 3.5 percent per year since FY 1982. In the intervening two years, practically coinciding with the rapid increase in civilian nurse compensation in 1980 and 1981, RMC increased by an average of 13 percent per year. Thus, the pressure that might have been placed on Nurse Corps recruiting and retention by higher civilian wages was avoided by the coincidental increase in military compensation. On the other hand, because Nurse Corps compensation is tied to overall military compensation, and not to cycles in the civilian nurse market, the Nurse Corps is subject to periodic shortages and surpluses in recruiting and retention.

The Current Nurse Shortage

The current nurse shortage has received high-level and broad-based attention since its scope and severity were documented to be similar to the last national nurse shortage of 1979. In December 1988, the Department of Health and Human Services released the final report of the *Secretary's Commission on Nursing* [5]. It documents the shortage through nurse vacancy rates in civilian hospitals and other health care environments, relying on studies like [2] and data provided by health care provider organizations. For example, it was noted earlier that the nurse vacancy rate in civilian hospitals nearly tripled between 1985 and 1987. The increase is attributed to an increase in demand for nurses at current wage rates, rather than a decrease in the supply of nurses.

Data are presented in [1, 2, and 5] that indicate hospitals have substituted RNs for other staff as health care cost-reduction incentives have become more important. Despite fewer patients and beds, the demand for nurses by hospitals has remained high. This continuing demand for

1. RMC includes basic pay, basic allowance for quarters, variable housing allowance, basic allowance for subsistence, and tax advantage (associated with the nontaxable allowances).

RNs has resulted in a doubling of the ratio of nurses to patients, from about 50 per 100 patients in 1972 to about 90 per 100 patients in 1986. Increasing severity of patient illness is thought to account for part of the rise in the ratio of nurses to patients. The Department of Labor has projected that the demand for RNs (at forecasted wage rates) will continue to exceed the supply throughout the 1990s. If compensation packages are improved significantly, the number of RNs demanded will decline and the number of RNs supplied will increase. In such a scenario, a new equilibrium with higher compensation and more employed nurses is to be expected.

COMPENSATION, BENEFITS, AND WORKING CONDITIONS

Of necessity, this study focuses on the compensation of nurses exclusive of benefits and working conditions. But of course military benefits, lifestyle, and working conditions are important considerations in an individual's choice between civilian and military employment. In particular, a change in military compensation is an incomplete indicator of the attractiveness of military service. For example, the current civilian nurse shortage led first to many noncompensation (i.e., non-wage) employment incentives being offered by hospitals and other nurse employers. Prominent among these were (1) one-time startup bonuses (or finder's fees) and (2) tuition assistance.

Although hospitals use startup bonuses and finder's fees to recruit nurses, these incentives are not included in available salary surveys. No systematic survey of the use of such hiring incentives has been published. Such bonuses, however, enhance the likelihood that Navy nurses deciding on career options will leave the service to take civilian jobs, or will not join the Navy in the first place. The Health Care Advisory Board, representing the nation's major hospitals and health-care-related institutions, included such bonuses as relatively cost-effective in a 1988 evaluation of hiring strategies for hospitals.

Tuition assistance and other types of education subsidies are also rated highly as recruiting tools by the Advisory Board. These subsidies are also likely to be effective retention tools for those seeking additional training and upward mobility. Along these lines, the Navy offers the Medical Enlisted Commissioning Program (MECP) (see [4]), which contains many of the elements of civilian training assistance. In addition, Navy has plans to implement a Reserve Officer Training Corps (NROTC) program for nurses, as well as a Nurse Officer Candidate program. The latter program requires congressional approval. Both will subsidize the training of nurses in exchange for a longer active-duty obligation (four years versus three). Nurses have recently been

1. References to the Health Care Advisory Board are to a summary of its proprietary report entitled *The U.S. Nursing Shortage*, which CNA obtained in July 1988.

included in the Navy's Baccalaureate Degree Completion Program (BDCP), which subsidizes the completion of a degree program. However, the values of these subsidies are not included in wage surveys or military compensation data, even though they do affect recruiting and retention. (See [1] for retention data for the Nurse Officer Candidate Program that was discontinued in FY 1977.)

The number of hours of work, the scheduling of those hours, and working conditions are also important determinants of occupational choice, as well as complicating factors in the measurement of relative military compensation. In the civilian sector, the job characteristics associated with dissatisfaction are undesirable hours and inadequate staffing and promotion opportunities. In response to these dissatisfiers, civilian hospitals have shifted management of nursing units to nurses and have introduced a wide range of flexible scheduling options. One hospital is reported to offer up to 40 different scheduling plans, and part-time employment options have generally increased. Some of the market-induced options are equivalent to shift differentials. For example, under the "Baylor plan," nurses working two 12-hour shifts on the weekend are paid for a full 40-hour week.

On the other hand, military nurses report average work weeks of 50 to 55 hours [6]. Part-time, and even traditional 40-hour work weeks, may not be feasible for Navy nurses on active duty. The implicit value of civilian changes in hours, staffing, and promotion opportunities is not quantifiable within the scope of this study.

In summary, the current nursing shortage has led to improved offers of employment to civilian nurses that are not captured in wage surveys and are likely to influence an individual's career choice. The implication is that, because civilian hospitals have used such non-wage targeted adjustments to the total employment package, measures of relative military compensation based on wages and salaries presented in the following sections will show less decline in relative military compensation during the recent shortage than perceived by Navy nurses.

COMPARISONS OF NURSE CORPS COMPENSATION

Key Decision Points

The level of military Nurse Corps compensation has historically been high relative to that of civilian nursing. Table 1 presents comparisons at three different points during the first ten years of service. Each corresponds to a decision point: accession, the end of initial obligation, and the end of augmentation obligation. The military pay values are averages of Regular Military Compensation (RMC), as defined in [7], imputed from pay tables for the observed inventory of Navy nurses in each year.

Table 1. Nurse Corps: military-civilian pay differentials at decision points

Decision point	Fiscal year				
	1983	1984	1985	1986	1987
Accession					
Military (YOS 1 military pay) ^a	19,318	19,654	20,574	21,150	21,398
Civilian (staff RN starting pay) ^b	<u>-17,784</u>	<u>-18,564</u>	<u>-18,972</u>	<u>-19,800</u>	<u>-20,532</u>
	1,534	1,090	1,602	1,350	866
Initial obligation ^c					
Military (YOS 4 military pay)	29,845	30,167	30,723	30,426	31,626
Civilian (staff RN maximum rates)	<u>-24,228</u>	<u>-25,080</u>	<u>-26,496</u>	<u>-28,044</u>	<u>-29,436</u>
	5,617	5,087	4,227	2,382	2,190
Augmentation obligation ^d					
Military (YOS 7 military pay)	33,437	33,774	35,845	36,954	37,284
Civilian (head RN maximum rates)	<u>-29,436</u>	<u>-30,144</u>	<u>-33,000</u>	<u>-34,287</u>	<u>-35,988</u>
	4,001	3,630	2,845	2,667	1,296

- a. Military pay is average (over paygrade) imputed regular military compensation (RMC) with no dependents for the specified year of service. It includes basic pay, basic allowance for quarters, basic allowance for subsistence, variable housing allowance, and a federal tax advantage. The exception is that YOS 1 military pay for each year is measured by RMC (no dependents) for an O-1 with less than two years active duty (it is a single rate, not the average of rates).
- b. Civilian salaries are medians for each experience level from the University of Texas Medical Branch at Galveston, *National Survey of Hospital and Medical School Salaries*, for each year.
- c. The initial obligation for Navy nurses is three years active duty. Regular military compensation at four years of service is the current foregone income associated with leaving after completing the initial obligation. The maximum rates for civilian staff nurses probably overstate the compensation of civilian nursing options for these individuals.
- d. For this comparison, Nurse Corps members are assumed to augment from reserve to active duty commission at six years of commissioned service. The augmentation obligation was one additional year of service until 1985, when it was increased to two years. The civilian values for head nurses, maximum rates, probably overstate the compensation of civilian nursing options for these individuals.

The most complete historical civilian data are the annual surveys by the University of Texas Medical Branch (UTMB) at Galveston. The survey data are not rich enough to allow direct comparisons by years of experience. Instead, the survey collects salary information on starting and maximum rates for staff nurses, and starting and maximum rates for head nurses. Though the UTMB survey does not report such comparisons, other sources (which are less complete historically) indicate that the urban-rural and regional differences in civilian nurse compensation are significant.

The comparison of starting rates is straightforward and shows that the military advantage dropped by about \$800 per year between 1985 and 1987 (50 percent of the 1985 difference). The UTMB at Galveston indicates that the national average compensation for starting staff nurses increased by about 9 percent in 1988, and exceeded the starting rate for military nurses by about \$600 per year.

For nurses at the end of initial obligation, there are no strictly comparable civilian data. The UTMB survey of maximum salaries for civilian staff nurses is the only consistent measure of compensation for experienced nurses available annually. Because civilian staff nurses may take eight to ten years to reach maximum pay rates, these salaries probably overestimate the civilian compensation that nurses leaving at the end of initial obligation (three years active duty for direct accessions) could expect. However, because both the civilian and military earning-experience profiles are relatively stable over this period, the year-to-year changes in the military-civilian difference are probably more reliably estimated than the absolute size of the difference.

At the end of initial obligation, the opportunity cost of leaving the Navy is the compensation that could be expected in year of service four. (No annualized cost-of-leaving calculations with longer time horizons have been attempted.) The military-civilian difference fell by about \$2,900 per year between 1983 and 1987 (table 1), but military compensation maintained its advantage in 1987.

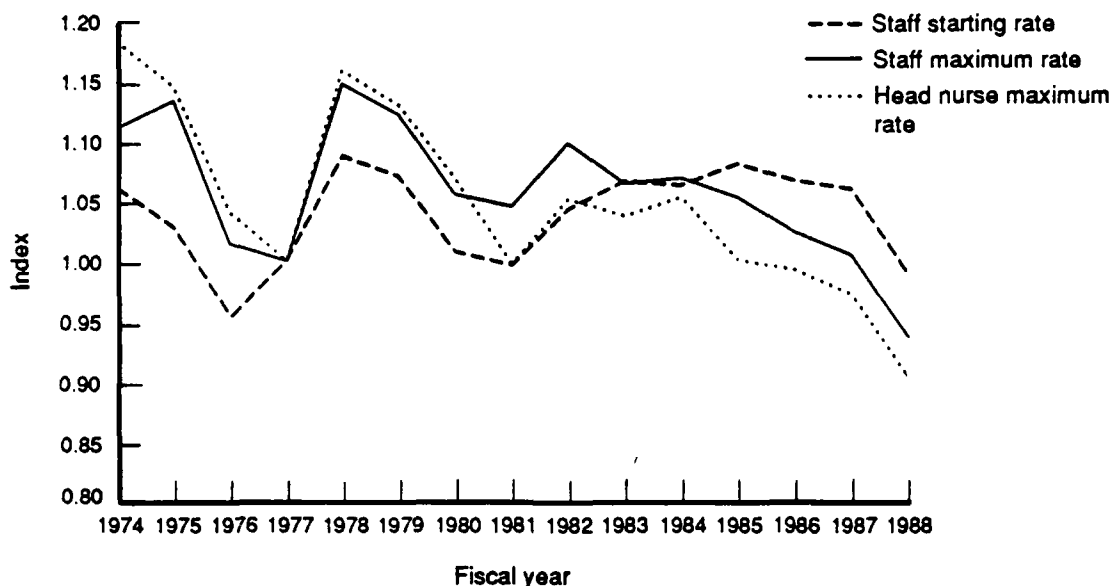
For more experienced nurses, the situation is similar. Though the amount of the military-civilian difference is affected by the level of experience inherent in the UTMB survey data, only the magnitude of the military compensation advantage is affected by the choice of experience level. Using the median of maximum civilian rates reported for head nurses, as in table 1, relative military compensation declined by \$2,300 per year for Navy charge nurses between 1983 and 1987. Though the maximum rates for head nurses may overstate the civilian earning potential of nurses with seven or eight years of Navy service, military RMC remained higher in 1987 than the median maximum salary of head nurses in the UTMB survey.

Long-Term Trends in Military and Civilian Nurse Pay

Figure 1 displays indexes of changes in RMC rates relative to civilian nurse compensation from 1974 through 1988. Once again, the source of civilian nurse compensation data is the UTMB annual survey. All indexes are normalized to 1977 values.¹ Indexes of relative military pay are presented for starting staff nurses, experienced staff nurses, and charge nurses. Index values greater than 1 represent higher relative (to civilian) military compensation rates than observed in 1977.

- The relative starting rate for military staff nurses increased with the decline in civilian nurse compensation in 1978 and 1979. The sharp rebound in civilian nurse compensation in 1980 and 1981 negated the large military pay raise in 1981, though the 1982 military pay raise does register as expected. From 1983 through 1987, the index shows little change as military and civilian nurse pay increases nearly matched each other. The relative starting rate for military staff nurses fell 7 percent in 1988 and likely will fall again in 1989. The expected decline in relative starting pay will make recruiting even more difficult in 1989 than it was in 1988 (the first year in recent history that Navy (and Army) nurse recruiting goals were not met).
- Relative military compensation for experienced staff nurses, controlling for military pay grade, has fallen by about 15 percent since 1982. In 1988, the index was 6 percent below its previous (1977) minimum, and is expected to fall even further in 1989. This will place additional pressure on retention at initial obligation, as well as continuation through six to eight years of commissioned service.
- Relative military compensation for charge nurses, controlling for military paygrade, has fallen by about 14 percent since 1982, and was at a historical low in 1988. It is expected to fall even further in 1989, putting pressure on retention of more experienced nurses.

1. Excluding the Federal Tax Advantage, an O-3 with three years of service completed would have received \$1,419 per month in basic pay and allowances during FY 1977. By comparison, the median maximum salary of civilian staff nurses in the 1977 UTMB survey was \$1,338 per month. The index values provide direct comparisons to these base year values. The relative pay changes can, of course, be scaled to any other year during the period.



NOTE: RMC index from [7]. Civilian nurse data from [8], medians for each rate. The indexes are calculated as RMC divided by the civilian nurse medians for each rate.

Figure 1. Navy Nurse Corps: relative military compensation indexes

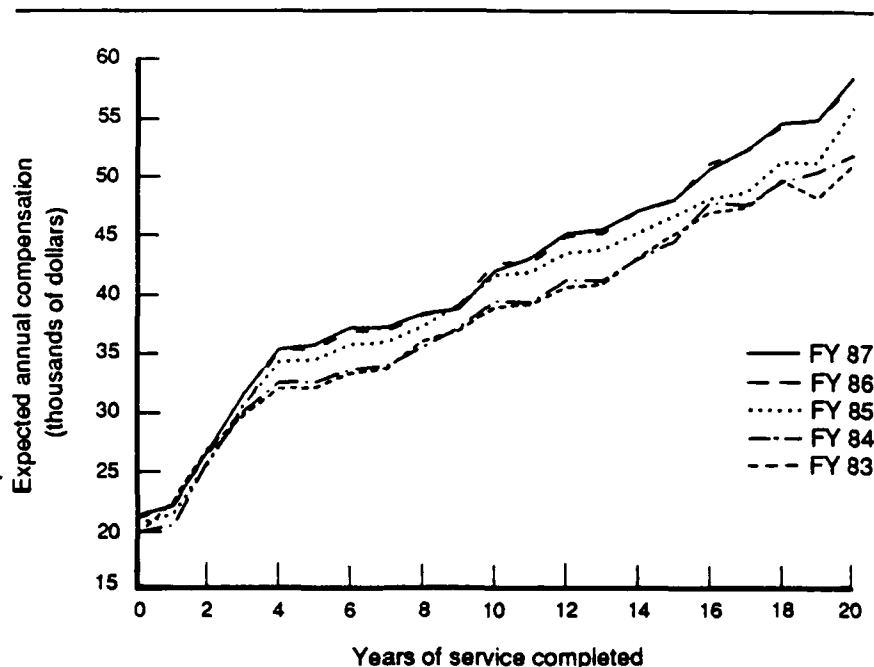
These longer-term comparisons consider pay rates only. They do not include the effect of changing military promotion patterns on compensation. In fact, reduced promotion opportunity and lack of constructive credit for civilian experience between September 1981 and December 1987 have added to the decline in relative military compensation that would have occurred anyway.

It should be noted that the civilian compensation data represent national aggregates and mask substantial regional and urban-rural variation. Whether or not the regional variation has strong effects on retention behavior is an empirical question concerning which few data are available. Such variation may be important, however, if Navy nurses are attracted to the higher compensation available in urbanized areas, and if there has been a disproportionately large increase in nurse compensation in the highest wage urban areas.

Nurse Corps Compensation With Experience Profiles

Civilian nurses have historically had small pay gains associated with experience. Figure 2 shows the expected annual compensation of Navy nurses by years of completed service. During the first four years of service, Nurse Corps compensation increases 10 to 11 percent per year, on average. For years of service 4 through 20, RMC increased an average of 3.1 percent per year of service in 1983 and 3.5 percent per

year of service in FY 1987. The compensations for experience in civilian nursing are generally acknowledged to be small relative to those of other occupations. The American Nurses' Association provides a comparison of career wage growth across civilian occupations (see appendix A). It shows nursing to have one of the slowest wage growth profiles in the service sector.



NOTE: Regular military compensation with no dependents

Figure 2. Navy Nurse Corps: compensation by years of service

Civilian Nurse Compensation With Experience Profiles

To provide additional quantitative information on wage profiles in civilian nursing, employment data on nurses were collected from the Current Population Survey of the U.S. Census for the years 1983 through 1985. The sample used to estimate nurse earnings profiles was selected to be representative of Navy nurses. The nurses in the sample are employed full-time, are ages 22 through 40, and have completed at least a bachelor's degree. The characteristics of the sample are listed in table 2.

Table 2. Characteristics of CPS nurse sample

Variable	Mean	Standard deviation
NONWHITE	0.152	0.360
WOMAN	0.926	0.262
CITY	0.309	0.462
SUBURB	0.340	0.474
MARRIED	0.533	0.500
EDLEV2	0.123	0.329
EDLEV3	0.133	0.340
AGE	30.45	4.69
AGE2	948.94	293.05
YEAR	1.10	0.824
LOGWAGE	6.028	0.254

Number of observations: 512

The variables used to explain earnings differences require some discussion. The first seven variables in table 2 take only the values 0 or 1. For example, the mean for the variable WOMAN indicates that 92.6 percent of the individuals in the sample are women. The variables representing education level (EDLEV2 and EDLEV3) distinguish between those with one year completed beyond college (EDLEV2 = 1), those with two or more years completed beyond college (EDLEV3 = 1), and those completing only 4 years of college (EDLEV2 = 0, EDLEV3 = 0). The sample proportions in different types of areas (city, suburb, rural) are similar, with about one-third of the sample in each. Most important, AGE (and AGE2 = AGE x AGE) serves as a proxy for experience and is formulated to capture an expected diminishing returns to experience. The average age in the sample is about 30 years. The YEAR variable identifies 1983 (YEAR = 0), 1984 (YEAR = 1), and 1985 (YEAR = 2) observations. The compensation measure used is the reported wage/salary for each individual. The estimated earnings regression is as follows:

$$\begin{aligned} \text{Log(WAGE)} = & \text{CONST} + a_1\text{YEAR} + a_3\text{AGE} + a_4\text{AGE2} + a_5\text{EDLEV2} + a_6\text{EDLEV3} \\ & + a_7\text{CITY} + a_8\text{SUBURB} + a_9\text{MARRIED} + a_{10}\text{WOMAN} + a_{11}\text{NONWHITE} + e \end{aligned}$$

where the error term (e) is assumed to have a mean of zero and a constant variance.

The results of the ordinary least squares regression are presented in table 3. Controlling for education, urban-rural location, year, and socioeconomic factors, the regression can be used to estimate the additional compensation associated with additional experience. The percentage increase in compensation per year of experience is found from the regression equation to be $\Delta W = 0.084 - 2(0.001)25$, or 3.5 percent per year at age 25.¹

Table 3. Results of civilian nurse compensation regression

Variable	Parameter estimate	Standard error
CONST	4.502	0.474
YEAR	0.056	0.013
AGE	0.084	0.031
AGE2	-0.001	0.000
EDLEV2	0.039	0.032
EDLEV3	0.081	0.032
CITY	0.055	0.026
SUBURB	0.046	0.025
MARRIED	-0.053	0.021
WOMAN	-0.087	0.040
NONWHITE	-0.011	0.030
Adjusted R ²	0.18	
Observations:	512	

Thus, compensation of Navy Nurse Corps officers is estimated to increase about three times faster with experience during the initial obligation than civilian nurse compensation. Also, based on these regression results, the compensation for experience for Nurse Corps officers during 4 to 20 years of service is similar to that in civilian nursing. Note, however, the important omission of the substantial military retirement benefit, which, if included, would increase the expected value of additional military service during these years.²

1. Age 25 was chosen to evaluate the expression because it is approximately the age at which Navy Nurse Corps officers reach the end of their initial obligation. The rate of change can be evaluated for any relevant age by substituting it for 25 in the expression for ΔW . It declines with age.

2. However, a Nurse Corps officer who leaves before retirement receives no value from this benefit.

Unmeasured civilian benefits, shift differentials, and working conditions partly offset this omission. Finally, the earnings regression cannot control for continuous employment in nursing. It may be the case that earning profiles for civilian nurses continuously in the labor market full-time are steeper than estimated here.

The Effect of Changing Navy Promotion Opportunity

In combination with experience, or longevity, promotion rates determine Nurse Corps compensation. A reduction in promotion opportunity between FY 1983 and FY 1987 adversely affected Nurse Corps compensation at the same time that civilian compensation was rising more quickly.

Table 4 shows average imputed RMC by years of service for 1983 and 1987. Within a year-of-service cell, the variation in RMC is due to differences in paygrade or rank. The military pay for each nurse is imputed from the RMC table for the appropriate year. Columns 1 and 3 use the actual-paygrade-by-years-of-service distributions in those two years, and column 2 uses the paygrade-by-years-of-service distribution of 1983 to impute a hypothetical 1987 RMC. The difference in RMC between columns (2) and (3) is thus associated with a different paygrade distribution by years of service. The last column (4) shows the percentage change between column (1) and column (3) by years of service. If promotion opportunity had remained unchanged, average RMC would have risen by 11 percent between 1983 and 1987, that is, all years-of-service cells would show an 11-percent increase in column (4). Because of reduced promotion opportunity to paygrades O-3, O-4, and O-5, the nominal pay changes for years of service corresponding to these promotion zones are significantly less than 11 percent. For years of service 2 and 3, nominal RMC (not adjusted for inflation) fell by 1 or 2 percent between 1983 and 1987. Depending on experience level, the earnings of civilian staff nurses increased 15 to 20 percent during the same period. The combination yields an estimated 16- to 22-percent decline in relative military compensation for nurses since 1983 in the last year of their initial obligation.

NURSE ANESTHETIST COMPENSATION

One of the Nurse Corps specialties of particular concern is nurse anesthetists. The Navy had 137 nurse anesthetists at the end of FY 1987, including those in training provided by the Navy. As for other Nurse Corps officers, nurse anesthetist compensation was RMC during the years analyzed. Two sources provide compensation data for civilian nurse anesthetists. In addition to the UTMB at Galveston survey, the American Association of Nurse Anesthetists (AANA) surveys their membership annually. All UTMB data are based on a standard 40-hour work week and do not include overtime or on-call pay.

**Table 4. Navy Nurse Corps: pay changes, by years of service--
1983 through 1987**

	(1)	(2)	(3)	(4)
Years of service	Average imputed 1983 RMC	Average 1987 RMC at 1983 grade structure	Average imputed 1987 RMC	Percentage increase in average imputed RMC: 1983-1987
1	19,754	21,890	21,446	9
2	22,653	25,129	22,231	-2
3	27,056	30,077	26,852	-1
4	29,844	33,204	31,626	6
5	32,144	35,834	35,462	10
6	32,231	35,929	35,820	11
7	33,437	37,302	37,284	11
8	33,785	37,671	37,264	10
9	36,095	40,202	38,449	6
10	36,995	41,161	38,857	5
11	38,998	43,437	42,063	8
12	39,248	43,702	43,141	10
13	40,725	45,409	45,203	11
14	40,974	45,647	45,564	11
15	43,248	48,117	47,184	9
16	45,191	50,038	48,124	6
17	47,091	52,244	50,767	8
18	47,475	52,647	52,354	10
19	49,853	55,330	54,727	10
20	48,324	53,733	54,980	14

During the data collection for this study, the latest available AANA survey results were for 1986. The median income reported by members of AANA was \$45,800, about 18 percent of which consisted of fee for service, overtime, on-call, and bonus pay. Median RMC for Navy nurse anesthetists in FY 1986 was \$48,100. The median maximum salary for nurse anesthetists in the UTMB survey for 1987 was \$43,500, as compared to a median RMC of \$48,500 for Navy nurse anesthetists. The AANA speculates that nurse anesthetist incomes have risen at least 5 percent per year since 1986. However, the 1988 UTMB at Galveston survey shows a median maximum rate of \$49,092, which is nearly 13 percent higher than 1987. Median RMC for Navy nurse anesthetists was \$51,700 in FY 1988.

COMPENSATION AND RETENTION AT THE END OF INITIAL OBLIGATION

As reported in [1], the most critical career decision point affecting overall retention is at the end of the initial obligation. For this reason, and because the relationship between pay and retention is thought to be important, the relation between relative compensation and

retention is analyzed for nurses at the end of initial obligation between FY 1983 and FY 1987. Approximately 950 such career decisions are observed in the Bureau of Medicine Information System (BUMIS) data for the Nurse Corps. As background, figure 3 presents information on relative military-civilian compensation at the end of initial obligation for Nurse Corps officers. The civilian data are from the same source as in table 1, except that the 25th, 50th, and 75th percentiles of the reported civilian maximum staff nurse salaries are all included (rather than just the 50th percentile). For comparison, RMC values at the same percentiles in the Nurse Corps compensation distribution are also shown. As before, the military pay for each nurse is imputed from the RMC table for the appropriate year. The same caveats regarding comparability, benefits, and working conditions apply here as earlier.

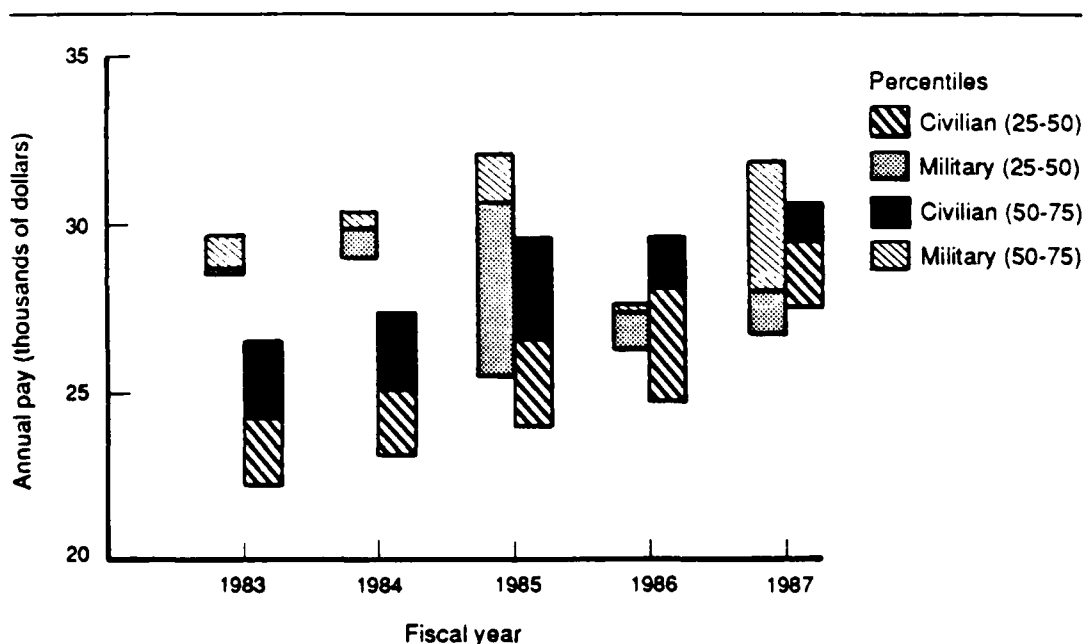


Figure 3. Navy Nurse Corps: military-civilian pay distributions at initial obligation

In FY 1983 and FY 1984, the compensation of Navy nurses at the 25th percentile exceeded the 75th percentile of the maximum compensation of civilian staff nurses. The Navy RMC distribution spread out substantially in FY 1985, though the median Navy compensation still exceeded the 75th percentile of the civilian staff nurse maximum salary distribution. In FY 1986, Navy Nurse Corps compensation for those at the end of initial obligation fell substantially while civilian compensation continued to increase. In both FY 1986 and FY 1987, the median civilian nurse compensation exceeded the median Navy nurse compensation.

Table 5 reproduces a portion of a similar table in [1] that shows Nurse Corps retention at the end of initial obligation (see [1] for details concerning the tabulation). It varies from a low of 57 percent retained in FY 1987 to a high of 75 percent retained in FY 1985.

**Table 5. Nurse Corps:
percentage retained at
end of initial obligation**

Fiscal year	Percent retained
1983	71
1984	67
1985	75
1986	67
1987	57

A Model of the Stay-Leave Decision at the End of Initial Nurse Corps Obligation

A logistic regression model is used to analyze the stay-leave decisions of nurses at the end of initial obligation. The logistic regression model is motivated by assuming that individuals maximize utility by choosing to stay in or leave the Nurse Corps. Appendix B describes the logistic regression model and results in detail. The remainder of this section summarizes the variables used in the analysis, and the results regarding compensation differences. Several variables in addition to the compensation differential are used to "explain" the observed pattern of decisions. These variables are listed in table 6.

The variables in the model have names that indicate their meaning. SPECIALIST (= 1) indicates that the individual was classified as having a nursing specialty at the time of the decision. The pay difference (PAYDIFF) for each individual is imputed from the RMC tables and UTMB survey data as described in table 1. On average over the period, foregone military compensation for leavers exceeded the imputed civilian salary by about \$2,100 per year. The EXPERIENCE variable is intended to capture the amount of Navy pre-Nurse Corps experience of individuals. It is computed as the difference between the fiscal year of active commissioning base date and the year of the individual's completion of his/her education program. EDUCATION (= 1) indicates individuals who have not obtained at least a bachelor's degree. Fiscal year dummies are included to account for unobserved effects of the transition to lower promotion opportunity in the Nurse Corps.

Table 6. Independent variables used in logistic analysis of retention

Variable	Mean	Maximum	Minimum	Standard deviation
SPECIALIST	0.130	0	1	0.34
PAYDIFF	2,112.6	6,756.0	-6,289.0	3,192.2
EXPERIENCE	2.13	15	0 ^a	2.52
EDUCATION	0.15	0	1	0.36
FY 1985	0.165	0	1	0.37
FY 1985	0.355	0	1	0.48

Number of observations: 955

a. One person completed his/her education during the third year of obligation. In this case, the experience variable takes the value -3. The observation is included despite this fact. It has little influence on the overall results.

The Effect of Changes in Compensation

The focus of interest in this analysis of the stay-leave decision is the effect of changes in relative compensation (PAYDIFF) on retention. To quantify the effect, it is necessary to assign cardinal rather than ordinal significance to the predicted probabilities for each observation. Though several potential problems are associated with using probabilistic regression models for this purpose, the logistic model has at least one relative advantage; that is, the sample proportion of leavers is equal to the mean of predicted probabilities of leaving for the sample. Thus, evaluating the change in the mean predicted probability of leaving for all individuals in the sample may be a reasonable predictor of the change in the proportion of leavers. The more usual alternative procedure is to evaluate the change in predicted probability for a "representative" individual, that is, one with mean value of all the independent variables. Both procedures are applied to a hypothetical change in PAYDIFF in table 7.

As is clear in table 7, the method of evaluation makes little difference in this case, though in general, it may. A 10-percent increase in civilian compensation rates during 1989, along with a 4-percent RMC increase would result in a decline in relative pay at the end of initial obligation of about \$1,500 per year. Using the results of the logistic regression, a \$1,500 decline in relative annual military pay is expected

to lead to a decline of three to four percentage points in the retention rate at the end of initial obligation. This translates to approximately 10 additional losses for a cohort of 300 individuals.

Table 7. Predicted retention effects of a \$1,500 decrease in relative annual military pay at end of initial obligation

	Probability of leaving	Probability of leaving with \$1,500 decrease in PAYDIFF	Estimated change in retention
At sample mean	0.336	0.373	-0.037
Mean of sample	0.344	0.379	-0.035

SUMMARY

This research memorandum has examined Navy Nurse Corps compensation and retention at the end of initial obligation. The principal findings are the following:

- Nurse Corps compensation has historically been high relative to civilian nurse compensation.
- Civilian nurse pay rates, adjusted for experience, rose faster than Regular Military Compensation (RMC) between 1983 and 1988. Because data on the value of non-wage compensation and benefits are not available, this conclusion is based on a comparison of wage compensation only.
- During the first four years of service, Nurse Corps compensation increases about three times faster with

1. The level of the military/civilian pay differential based on current pay may understate the difference based on expected lifetime earnings if military compensation and benefits are loaded more toward the end of the "career." Because of the measurement problems noted earlier, it is also likely that the change in the military/civilian pay differential has been underestimated in terms of current pay, and probably in terms of expected lifetime earnings. The underestimation of the compensation change is probably greater in terms of current pay than expected lifetime earnings. If the actual changes are larger than the measured changes, then the effects of compensation changes on retention are overestimated in the logistic regression.

experience (10 to 11 percent per year on average) than does civilian nurse compensation. For years of service 4 through 20, Nurse Corps compensation has increased just over 3 percent per year. Excluding expected military retirement benefits, this is similar to civilian nurse compensation profiles. Including the value of military retirement benefits is likely to increase the relative compensation of military nursing.

- Navy Nurse Corps compensation at the end of initial obligation (three years of service) declined 16 to 22 percent relative to civilian nurse compensation between 1983 and 1987. This was due largely to reduced promotion opportunity in the Nurse Corps and increasing civilian nurse compensation.
- In 1986, the median RMC of Navy nurse anesthetists exceeded the median reported income of the members of the American Association of Nurse Anesthetists. More recent evidence indicates that civilian nurse anesthetist compensation has been increasing more quickly than regular military compensation.
- Nurses at the end of initial obligation may observe a decline of about \$1,500 in annual relative military compensation during FY 1989. Such a change is estimated to be associated with a loss rate three to four percentage points higher than if there were no change in relative military compensation. This translates to about ten additional losses in a year.

Relative military compensation influences both recruiting and retention. Though Nurse Corps compensation, exclusive of important benefits like retirement annuities, has declined relative to civilian nurse compensation over the past five years, there is little empirical evidence of a substantial reduction in retention, in particular, at the end of initial obligation. By contrast, the recruiting of nurses has become much more difficult for all the services. More attractive offers to starting nurses may be necessary to obtain the desired number of Nurse Corps accessions. If the civilian nurse labor shortage continues and civilian compensation continues to climb, it will be desirable to reevaluate the link between compensation and retention, especially if manning shortfalls occur because of unexpectedly high losses of experienced nurses. In the process, a systematic comparison of changes in non-wage compensation, benefits, and working conditions may be required.

REFERENCES

- [1] CNA Research Memorandum 89-64, *Navy Nurse Corps Retention; FY 1974-1988*, by Timothy W. Cooke, forthcoming (27890064)¹
- [2] Linda H. Aiken and Connie F. Mullinix. "The Nurse Shortage: Myth or Reality." *The New England Journal of Medicine*, 317 (3 Sep 1987): 641-646
- [3] D.E. Yett. *An Economic Analysis of the Nurse Shortage*. Lexington, MA: Lexington Books, 1985
- [4] Naval Medical Command, NAVMED P-5128, *Officer Career Guide*, 1985
- [5] Secretary of Health and Human Services. *Secretary's Commission on Nursing: Final Report*, Vol. I, Dec 1988
- [6] Navy Occupational Development and Analysis Center (NODAC), *Medical Community Navy Occupational Task Analysis Program (NOTAP)*, Washington, D.C., 1988
- [7] Office of the Secretary of Defense, *Military Compensation Background Papers*, 3rd ed., Washington, D.C., 1987
- [8] University of Texas Medical Branch at Galveston, *1987 National Survey of Hospital and Medical School Salaries*, Galveston, TX: UTMB at Galveston, 1987

1. The numbers in parentheses are internal CNA control numbers.

APPENDIX A

AMERICAN NURSES' ASSOCIATION COMPARISON OF SALARY
PROGRESSION IN VARIOUS OCCUPATIONS

APPENDIX A

AMERICAN NURSES' ASSOCIATION COMPARISON OF SALARY PROGRESSION IN VARIOUS OCCUPATIONS

The American Nurses' Association is the national, professional organization representing the nation's 1.9 million registered nurses through its 53 constituent state and territorial nurses' associations. Table A-1 was provided by the association in response to a request for salary information. For more information contact: Communications Unit, American Nurses' Association, 2420 Pershing Road, Kansas City, Missouri 64108 (telephone (816) 474-5724).

Table A-1. 1986 salary progression in various occupations

Occupation	Average starting salary	Average maximum salary	Percent salary progression in field
Accountants	\$21,024	\$61,546	192.7
Attorneys	31,014	101,169	226.2
Buyers	21,242	41,304	94.4
Computer programmers	20,832	42,934	106.1
Personnel directors	39,817	75,170	88.8
Chemists	22,539	74,607	231.0
Engineers	27,866	79,021	183.6
Accounting clerks	12,517	21,872	74.7
Personnel clerks/assistants	14,193	23,702	67.0
Purchasing clerks/assistants	13,994	29,834	110.0
Secretaries	16,326	28,051	71.8
General clerks	10,478	19,332	84.5
Staff registered nurses	20,340	27,744	36.4

SOURCES: National Survey of Professional, Administrative, Technical and Clerical Pay, U.S. Department of Labor, Bureau of Labor Statistics, Oct 1986 (Bulletin 2271), pp. 11-13. Staff nurse salaries from National Survey of Hospital and Medical School Salaries, 1986, University of Texas Medical Branch at Galveston, 29.

NOTE: Salary progression figures represent the differences between national average starting and maximum salaries in a given profession or occupation for a certain year, in this case, 1986.

APPENDIX B

A LOGISTIC REGRESSION MODEL OF THE STAY-LEAVE DECISION
AT THE END OF INITIAL NURSE CORPS OBLIGATION

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A LOGISTIC REGRESSION MODEL OF THE STAY-LEAVE DECISION AT THE END OF INITIAL NURSE CORPS OBLIGATION

Let U_s and U_l denote the utilities of the two choices, staying and leaving, respectively, for an individual. Let z_s and z_l be characteristics of the alternatives as perceived by the individual, and w , a set of characteristics of the individual. Then, suppose that U_s and U_l can be written as follows:

$$U_s = \bar{U}_s + e_s = a_s + bz_s + c_s w + e_s$$

$$U_l = \bar{U}_l + e_l = a_l + bz_l + c_l w + e_l .$$

The individual is presumed to leave if $U_l > U_s$, and the probability of this is given by the following expression:

$$Pr(U_l > U_s) = Pr[(e_s - e_l) < (a_l - a_s) + b(z_l - z_s) + w(c_l - c_s)] .$$

Letting $X = (1, z_l - z_s, w)$ and $B = [(a_l - a_s), b, (c_l - c_s)]$ yields $Pr(U_l > U_s) = F(xB)$. In the logistic regression model, $F(xB) = 1/(1 + e^{-xB})$.

The logistic model, as outlined above, has been the most frequently used by military manpower planners to analyze stay-leave decisions. The choice of the logistic function does impose some restrictions on the estimated relations between the individual characteristics and the probability of leaving the Nurse Corps at the end of the obligation. Specifically, changes in independent variables (x_i) have their greatest impact on the probability of leaving at the midpoint of the distribution. For values of x associated with low or high probabilities of leaving, relatively large changes in x are necessary to bring about a small change in the probability of leaving.

The results of the maximum likelihood estimation are presented in table B-1. Though the coefficients in table B-1 indicate the direction of the change in the estimated probability of leaving and the associated variable, they do not represent the magnitude of the change in

probability. The magnitude of the estimated probability change (as the independent variable changes) depends on the values of the independent variables at which the probability function is evaluated. For nonlinear models like the logit regression used here, the procedure for evaluating the probability change may be important.

Table B-1. Logit regression results: leave
at end of initial obligation

Variable	Coefficient	Significance level
INTERCEPT	-0.324	0.017
SPECIALIST	-0.958	0.000
PAYDIFF	-0.108	0.000
EXPERIENCE	0.082	0.009
EDUCATION	0.248	0.220
FY 1985	-0.498	0.018
FY 1986	-0.377	0.033
$x_6 = 42.26 (0.000)$		

The Statistical Analysis System (SAS) procedure¹ used to estimate the model provides several measures of the "predictive" ability of the results. Classification tables are frequently used to show the number of cases predicted correctly, but are sensitive to an arbitrary classification cutoff probability. For example, observations are usually classified as predicted leavers if the imputed probability of leaving exceeds 0.5. In this sample, however, only 34 percent of the individuals chose to leave, and the mean predicted probability of leaving is 0.34. In this case, a better option for the classification table cutoff probability might be 0.34. However, because of the arbitrary nature of the classification criterion, another measure of predictive ability is used.

The concept of concordance is recommended in the *SAS User's Guide* as a better gauge of model performance.² Predicted probabilities of leaving for a pair of observations with different observed outcomes are said to be concordant if the predicted probability of leaving for the "leaver" observation is larger than the predicted probability of leaving for the "stayer" observation. Let c be the fraction of all pairs of

1. See SAS Institute, Inc., *SAS User's Guide: Statistics*, Version 5 ed., Cary, NC: SAS Institute, Inc., 1985.

2. The following discussion follows closely that in the *Guide*.

observations with different observed outcomes that have concordant predicted probabilities, plus one-half the fraction of tied pairs. A statistic called Somer's $D_{yx} = 2(c - .5)$ is an index of the rank correlation between predicted probabilities and observed outcomes. For the model estimated in table 7 (page 17) the fraction of concordant pairs is 0.624 and $D_{yx} = 0.247$. Nearly two-thirds of all pairs of observations with different observed outcomes have predicted probabilities of leaving that are consistent with the observed decisions.